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RESEARCH DEPARTMENT

STANDARDS CONVERSION IN GERMANY (1959)

Report No. A-058

(1960/20)

THE BRITISH BROADCASTING CORPORATION
ENGINEERING DIVISION

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1. INTRODUCTION

Together with L.E. Weaver of Designs Department, the writer visited the annual convention of the Fernseh Technische Gesellschaft at Darmstadt from 7th to 11th September 1959. A technical memorandum[1] giving an account of the convention programme and activities has been issued.

During the visit, the writer took the opportunity to discuss current problems of standards conversion with German engineers and inspected some typical converter equipment. This account deals with the information obtained in this context.

2. DEVELOPMENTS BY FERNSEH G.m.b.H.

An appreciable amount of work on standards conversion has been carried out in the laboratories of Fernseh G.m.b.H. Until a short time ago effort was solely devoted to the problems of conversion between European standards (i.e. standards having nominally equal field frequencies of 50 c/s), but in recent months an interest has been shown in the problems of conversion between standards having 50 c/s and 60 c/s field frequencies.

2.1. Conversion between Standards having 50 c/s Field Frequencies

Development of equipment suitable for this purpose started in 1954 when investigations were carried out into the relative merits of the image iconoscope and the image orthicon as the conversion camera tube. This work culminated in the supplying of converter equipment, incorporating a 3 in. image orthicon (type 5820), to the German Federal Post Office for use in Eurovision programme exchanges.

In recent years, improvements in the performance of the Vidicon tube have encouraged its adoption for conversion, and the Federal Post Office now uses equipment incorporating this tube. During a visit to the Fernseh Laboratories the writer was given the opportunity of inspecting a partly constructed Vidicon converter and discussing its design with the engineers responsible for its development. A detailed description has been published,[2] but in view of current interest some salient features will be outlined here.

A relatively small cathode-ray tube is used to display a picture 64 mm × 48 mm with a highlight brightness stated to be in the region of 2,000 ft-lamberts. The screen phosphor is willemite* having an approximately exponential decay characterized by a time constant of some 7 ms. It is claimed that the average phosphor-grain diameter is in the region of 10 μ. Means of preserving good focus over the image area include dynamic focusing, a final-anode potential of 28 kV and a maximum beam current of 200 μA. Tests have been carried out in order to determine the resolving capabilities of the cathode-ray tube, and a curve of brightness modulation depth plotted against video frequency (with the normal size of picture and 625-line scanning) shows a steady fall from 100% at low frequencies to 38% at 5 Mc/s.

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*It is of interest to note that Dillenburger has observed a slow increase in the efficiency of willemite over the first 50 hours of operation. For the same highlight beam current of 200 μA the increase in brightness amounted to some 30%.

The display circuits include most of the facilities usually found, such as a stabilizing amplifier and noise-resistant synchronizing circuits. The "spot-wobble" oscillator may be amplitude modulated, in a negative sense, by the video signal, so as to provide maximum line-broadening in picture areas of low brightness. It is claimed that, owing to enlargement of the scanning spot in areas of high brightness, the minimum amplitude of "spot-wobble" necessary for removing "line-beating" varies over the grey scale. It is very doubtful whether this facility can offer any appreciable improvement in performance over the conventional arrangement.

The camera employs a Vidicon tube, similar to the R.C.A. type 6326, in a deflection yoke designed to give good definition over the whole image area. Variations in sensitivity from point to point of the target surface, due to non-uniformity in the photo-conductive layer and in the beam-landing conditions,[3, 4] are compensated by a simple modulator located in the amplifying chain following the camera tube. The control signals supplied to the modulator consist of sinusoidal and parabolic waves at both line and field frequencies.

Gamma-correction circuits are located both before the display tube and after the camera pre-amplifier. The parameters of these circuits may be adjusted over a fairly wide range, but under normal circumstances the display amplifiers are operated linearly and the display-tube contrast range is limited to 25:1 by means of a fixed "sit". The resulting law connecting display-tube brightness with input signal voltage approximates to a gamma of 1·4. The camera tube, together with its corrector, has a characteristic approximating to a gamma of 0·7 which, when combined with that of the display, including the "sit", results in a reasonably linear amplitude relationship between the input and output of the converter.

Aperture correction is available in both display and camera amplifiers. The loss of resolution due to the display tube may be reduced by pre-correction such that, in the centre of the screen, the brightness modulation depth at a pattern frequency corresponding to 5 Mc/s has a value 70% of that obtained at low frequencies. The use of this pre-corrector, together with the further corrector following the camera tube, gives a horizontal resolution such that, when converting from 819 lines to 625 lines, the loss at 4·5 Mc/s in the converter output is 2 dB in the centre of the picture, and about 7 dB in the corners.

Under typical operating conditions, the ratio of picture signal to r.m.s. noise at the converter output approximates to 35 dB. Because of the capacitive impedance and low output current of the Vidicon, the noise spectrum has the familiar triangular form with the minimum at low frequencies.

Dillenburger has investigated the ability of the equipment to effect a satisfactory conversion when appreciable movement occurs in the input pictures. He finds that the converted picture may contain up to five unwanted "after images", these describing the scene during each of the preceding five input fields. It is stated that the "after images" are due solely to imperfect erasure of the target surface by the scanning beam but, with such a result, it is difficult to discount a possible further contribution by the relatively slow recombination of charge carriers in the target material.

Fig. 1 shows a view of the Fernseh Vidicon converter. The display tube and camera are supported on two small cabinets containing equipment associated with the display cathode-ray tube; this equipment includes amplifiers, deflection circuits and power supplies. Of the two larger cabinets, that on the left contains the camera channel together with suitable control and monitoring arrangements. The right-hand large cabinet contains the video processing circuits through which signals are passed before their application to the display, together with circuits for generating test signals, which may be used as the input in order to facilitate adjustment.

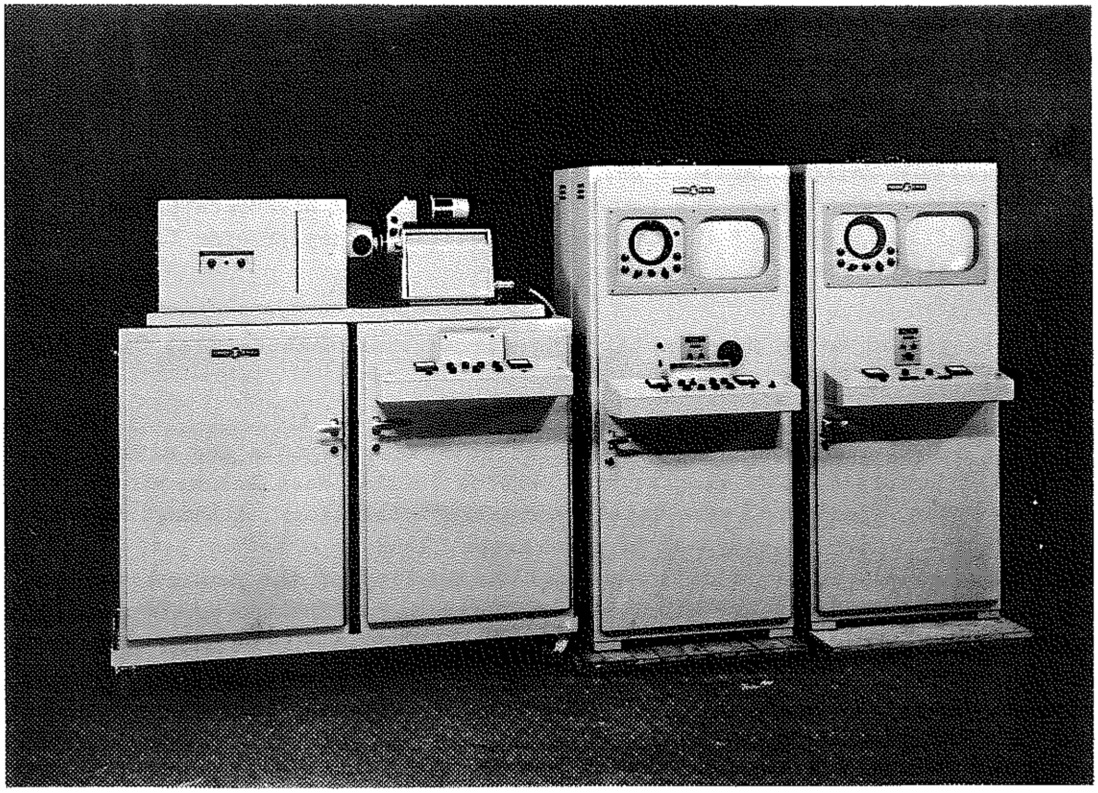

Fig. 1 - Vidicon standards converter developed by Fernseh G.m.b.H.

2.2. Conversion between 50 Fields/sec and 60 Fields/sec Standards

The lecture programme of the Fernseh Technische Gesellschaft included a paper by Sennhenn (Fernseh G.m.b.H.) which discussed the modification of the Vidicon converter so as to operate between European and North American television standards. The paper described a solution to the problem of "flicker modulation"[5] identical, in principle, to that used by Research Department.[6] Test results quoted showed that, for conversion from 60 fields/sec to 50 fields/sec, the output of the Vidicon is subject to an 11% variation at 10 c/s and an a.g.c. system was said substantially to eliminate this.

When asked by the writer to comment upon the portrayal of movement, Sennhenn replied that no tests with moving pictures had yet been made. In view of the considerable "after images" shown by the Vidicon converter (see Section 2.1) when converting between 50 fields/sec standards, it is likely that movement portrayal would be sufficiently marred by "smearing" to mask any image jerking due to the field-frequency difference.

No demonstration of the modified converter was seen and it was stated that none would be available until a working prototype had been developed. This was expected to be completed early in 1960 for delivery to one of the U.S.A. television networks.

3. CONVERTER INSTALLATION - COLOGNE

Discussion of standards conversion problems prompted Dr. Müller of the Fernmeldtechnische Zentralamt (West German "Dollis Hill") to suggest a joint visit to the installation at Cologne. The converter there is owned and operated by the German Federal Post Office as part of the television facilities they provide for the regional broadcasting authorities of the Republic.

It proved to be substantially identical with that seen at Darmstadt and described in Section 2.1.

A demonstration was given in which both test signals and moving pictures were used. Unfortunately, no signals from sources outside West Germany were available; the converter was, therefore, seen in a "repeating"* condition. Although this mode of operation might, under exceptional circumstances, lead to a better performance than that normally obtained, it is believed that the quality of the picture obtained was representative of a normal conversion. It appeared to confirm the performance figures quoted by Dillenburger.[2] As expected, the output showed appreciable smearing when moving pictures were used.

In discussion Dr. Müller stated that a comparison of performance had been made, on behalf of the E.B.U., between the Cologne installation and that operated by the B.B.C. near Dover. This test had led to the conclusion that the converters showed very similar characteristics with the exception of "movement smear", which was observed from the Cologne equipment when dealing with rapidly moving subject matter. In Dr. Müller's view this drawback was balanced by the fact that, owing to the use of the Vidicon, only one converter channel was necessary; in the B.B.C. converter, two converter channels are used alternately to avoid difficulties of image-orthicon "sticking" when converting still pictures.

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*The word "repeating" is intended to define circumstances where the standards of the converter input and output signals are nominally identical.

4. CONCLUSION

In the writer's opinion, the performance of the Fernseh converter is somewhat below that of the recently developed B.B.C. converter employing the C.P.S. Emitron. This is partly due to the use of a small image at the screen of the cathode-ray tube and the small target of the camera tube. It is possible that, by using a larger Vidicon together with a larger display cathode-ray tube of the type used in large-screen projection equipment, a significant improvement in performance could be obtained.

Nevertheless, it must be borne in mind that unless the brightness of the image on the larger Vidicon target is maintained at its present high value, the "movement smear" may become still worse than it is now.

5. REFERENCES

1. Designs Department Technical Memorandum 9.9(59).
2. Dillenburger, W., "Normwandler mit Vidikonkamera", Archiv der Electrischen Übertragung, Vol. 12, No. 5, 1958.
3. Neuhauser, R.G. and Miller, L.D., "Beam-Landing Errors and Signal Output Uniformity of Vidicons", J.S.M.P.T.E., Vol. 67, No. 3, March 1958.
4. Miller, L.D. and Vine, B.H., "Improved Developmental One-Inch Vidicon for Television Cameras", ibid.
5. Lord, A.V., "Conversion of Television Standards", The B.B.C. Quarterly, Vol. VIII, No. 2, Summer 1953.
6. Macnamara, T.C. and Spooner, A.M., British Patent 801,140.

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